US008329016B1

(12) **United States Patent**
Sommer et al.

(10) **Patent No.: US 8,329,016 B1**
(45) **Date of Patent: Dec. 11, 2012**

(54) **MICROFLUIDIC DEVICE HAVING AN IMMOBILIZED PH GRADIENT AND PAGE GELS FOR PROTEIN SEPARATION AND ANALYSIS**

(75) Inventors: **Gregory J. Sommer**, Livermore, CA (US); **Anson V. Hatch**, Tracy, CA (US); **Anup K. Singh**, Danville, CA (US); **Ying-Chih Wang**, Pleasanton, CA (US)

(73) Assignee: **Sandia Corporation**, Albuquerque, NM (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 560 days.

(21) Appl. No.: **12/551,047**

(22) Filed: **Aug. 31, 2009**

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/182,755, filed on Jul. 30, 2008.

(60) Provisional application No. 60/962,663, filed on Jul. 30, 2007.

(51) **Int. Cl.**
G01N 27/453 (2006.01)

(52) **U.S. Cl.** **204/605**; 204/644

(58) **Field of Classification Search** 204/600–605, 204/644

See application file for complete search history.

(56) **References Cited**

OTHER PUBLICATIONS

Das, C., et al. "Integration of isoelectric focusing with multi-channel gel electrophoresis by using microfluidic pseudo-valves", Lab on a Chip, vol. 7, 2007, pp. 1806-1812.*

Sommer, G. J. , et al. "On-chip isoelectric focusing using photopolymerized immobilized pH gradients", Analytical Chemistry, vol. 80, No. 9, May 1, 2008, pp. 3327-3333.*

* cited by examiner

Primary Examiner — J. Christopher Ball
(74) *Attorney, Agent, or Firm* — Timothy P. Evans

(57) **ABSTRACT**

Disclosed is a novel microfluidic device enabling on-chip implementation of a two-dimensional separation methodology. Previously disclosed microscale immobilized pH gradients (IPG) are combined with perpendicular polyacrylamide gel electrophoresis (PAGE) microchannels to achieve orthogonal separations of biological samples. Device modifications enable inclusion of sodium dodecyl sulfate (SDS) in the second dimension. The device can be fabricated to use either continuous IPG gels, or the microscale isoelectric fractionation membranes we have also previously disclosed, for the first dimension. The invention represents the first all-gel two-dimensional separation microdevice, with significantly higher resolution power over existing devices.

15 Claims, 15 Drawing Sheets